we believe it to be the same as our fourth, namely, that which passed us to the south on the 22d. (Extract to Bulletin of October 31, issued at 2 p. m.)

The assumption that the storm of October 31 was but a continuation of that of the 22d appears to be erroneous. It is not so considered in the October report from the Havana Forecast District, and Form 1001, which contain the monthly reports of meteorological observations, do not indicate that a storm prevailed in the Caribbean Sea and the Gulf of Mexico during the above period. We must consider these to have been two independent storms.

In the Avis for November 9 the editor devotes nearly all his space to a discussion of what he terms "harmless cyclones," or cyclones that are unaccompanied by hurricane winds. He points out, as Professor Bigelow has already done, in Vol. II, Report of the Chief of the Bureau, 1898–99, charts 31 and 35 and pp. 454–457, the difference between the circulation in a genuine West Indian hurricane and in ordinary cyclones, such as are common in temperature latitudes, and are occasionally experienced in the West Indies in winter.

Mr. Quin notes that "when the fall of the barometer announces the approach of a cyclone it is impossible at first to tell whether it is a harmless or a destructive cyclone." It is also noted that the absence of the ocean swell indicates the absence of hurricane winds, but no mention is made of the movement of the upper clouds in these mild or harmless cyclones, and we would suggest that this should be a very important observation. In temperate latitudes the ordinary cyclone, unlike the cyclone with hurricane winds, does not perceptibly deflect the direction of the upper clouds. Is not this also true in the Tropics?

In conclusion Mr. Quin says:

Now some of our readers may ask: What is the use of giving so much attention to a phenomenon which you admit to be without any serious danger; what good does that do to any one?

As one part of the answer, we would say that such a study strengthens our knowledge of the laws of the weather, and may one day be of great practical value to any one of us; and for the rest we would appeal to our fellow amateurs whether it is not an intense pleasure to be able to look out with the mental eye over a vast stretch of ocean and see the probable condition of the weather; to be able to follow one of these mysterious and grand natural movements in its course over seas and islands and to say what is likely to happen as it advances. As we remarked in a recent article, the establishment of the United States Weather Bureau in these West India Islands must increase the number of people who follow with intelligence the movements of cyclonic disturbances of all kinds during the hurricane season, and to such we hope that this rather long article will not be found unacceptable."

The editor of the St. Croix Avis is evidently an enthusiastic student of meteorology, and he is endeavoring to interest his readers in the subject, not alone because it will put dollars into their pockets, but because he appreciates the fact that knowledge of any science broadens one's mental horizon and elevates the man. It has been abundantly demonstrated, however, that a knowledge of meteorology and the ability to forecast the movements of storms is of the highest practical value.

We trust that the editor of the Avis will continue his observations, which we have no doubt will be even more interesting and valuable than at present after the receipt of the nephoscope that he has ordered, and that we may have the privilege of publishing his results.—*H. H. K.*

FRESH LIGHT ON THE ANTARCTIC.

The following quotations are from a review in Nature, vol. 65, page 153, of Louis Bernacchi's "To the South Polar Regions. Expedition of 1898–1900," which is an account of the cruise of the *Southern Cross* by its commander:

Mr. Bernacchi very clearly indicates the character of the antarctic summer, a period of low temperature and high wind, with very frequent fogs and rare intervals of clear weather. He states definitely that Mount Erebus was never clearly visible, merely a glimpse having been had of it—too short to allow a photograph to be taken. On February 19 the ship, as she lay at the ice barrier, was beset with young ice, and broke through with such difficulty that another day's delay would have meant another year.

The specially scientific part of the book is an appendix, though not so called, of fifty pages. It treats of the climate of the south polar regions, terrestrial magnetism, zoology, geology, astronomy, and concludes with miscellaneous notes and a short glossary of ice terms.

In discussing the climate, Mr. Bernacchi founds his remarks on a preliminary study of the observations taken at Cape Adare (latitude 73° south; longitude 171° east), which have been discussed at the Meteorological Office and are to be published by the Royal Society. The winter was not nearly so cold as at continental stations within the polar circle in the Northern Hemisphere, the absolute minimum recorded being —43.5° F. and the mean minimum of the coldest month, August, —22.7° F. On the other hand, the summer is very cold, the absolute maximum being 48.7° and the mean maximum of January (the warmest month, apparently, although there are no values for February), 37.0°; the mean temperature of this midsummer month was only 33° and the absolute minimum 25° F., but a short distance farther south minima below 0° F. were observed early in February. The most remarkable feature, however, was the wind. Windroses are given for each month of the year, showing that the southeastern quadrant of the horizon has an immense preponderance of winds in every month and a monopoly of gales. This is assumed as strong evidence of the existence of a great continental anticyclone to the south; and no doubt that theory is attractive and has much evidence in its favor. But the gales which burst from the east-southeast or southeast were invariably accompanied by a sudden and great rise of temperature, which in eleven cases cited ranged from nearly 14° to more than 44° F. This wind beat against Cape Adare from the level surface of the frozen sea, and does not suggest a foehn effect or an origin in the icy heart of a south polar anticyclone. Does it not rather indicate the passage of a cyclone center to the north and the sweeping in of air from the warm surface of the sea south of Australia? An anticyclone brooding over the southern land would probably tend to turn wandering cyclones eastward along its margin, and the two explanations are thus to some extent compatible.

A HISTORY OF METEOROLOGICAL WORK IN INDIA.

In the introduction to his administrative report for the year 1900–1901, Mr. John Eliot, Meteorological Reporter to the government of India and Director General of Indian observatories writes as follows:

The first part contains a brief history of the record of meteorological observations in India, and of the gradual development and progress of the Indian Meteorological Department. As this is probably the last administration report that I shall submit to the government, and as no connected account of the operations of the department has been published, it has been thought desirable that I should take the opportunity of my last year's connection with the department to prepare such an account, giving the history of the department up to the end of the nineteenth century, including the first twenty-five years of the existence of the department.

Meteorologists throughout the world will regret the retirement of this able investigator from the position he has filled since 1886. A brief synopsis of his history of meteorological work in India, which includes the work done under his own direction, is perhaps the most effectual way of summarizing for our readers the advancements in meteorology that may fairly be credited to Mr. Eliot.

The history of meteorological observations in India may be devided into three periods, as follows:

1. Previous to 1865, or period of local observation.
2. From 1865 to 1875, or period of provincial systems of meteorological observations.
3. From 1875 to date, or period of the present imperial system.

Period 1, previous to 1865.—Mr. Eliot says that amateur meteorological observers in India were confined to a few indigo and tea planters who recorded the rainfall and perhaps the temperature. Almost all meteorological records were therefore made under the direction of government officials; previous to 1865 the observers were usually unskilled assistants, the instruments furnished by the government were unreliable and often improperly exposed, and such records as were obtained were not properly preserved.

In consequence we are dependent for the meteorology of this early period upon the records obtained by the following observatories that were established by the East India Company for purely scientific purposes:

(1) The Madras Astronomical, Magnetical, and Meteorological Observatory.
(2) The Trivandrum Meteorological and Magnetical Observatory.
(3) The Dodabetta Meteorological Observatory.
(4) The Colaba (Bombay) Meteorological, Magnetical, and Time Service Observatory.
(5) The Calcutta Meteorological and Time Service Observatory.
(6) The Simla Meteorological Observatory.

The Madras Observatory was established in 1792. Meteorological observations were commenced in 1796, and have been maintained without interruption to the present time. Hourly magnetic and meteorological observations were commenced in 1822 and 1845, respectively, and were maintained until 1861.

The Colaba, or Bombay, Observatory was established in 1826; meteorological observations commenced in 1841, and have been continued without interruption to the present time.

A meteorological bungalow was established on the summit of Dodabetta, elevation 8,640 feet, and observations began in January, 1847. They were continued until December, 1855. It is proposed to reestablish this station early in 1902.

The Trivandrum Observatory in the extreme south of the peninsula, was established in 1841, and a substation, on the summit of one of the peaks of the Travancon Ghats in 1855. Both observatories have been continued to the present time.

The Simla Observatory was in operation from 1841 to 1845.

The Calcutta Observatory was established in 1853 and the observations have been continued to the present time.

Period 2, from 1865–1875.—It became apparent that the meteorology of India could not be studied satisfactorily through the work of independent observatories. An effort was therefore made to bring all the meteorological work in India under the direction of a general superintendent. The scheme proposed by the Asiatic Society of Bengal was as follows:

1. A superintendent or director for the whole of India, to whom the local reporters should be subject.
2. Local or provincial reporters for each province.
3. Observatories: (*a*) At the headquarters of the provincial governments under the direct control of the provincial reporters. (*b*) At large hospitals and at selected civil stations.
4. Volunteer agency to be utilized as much as possible in order to obtain marine data, and data of the chief planting districts.

This scheme was practically adopted in 1865, except that no general superintendent was appointed. The provincial governments, however, generally appointed reporters, Mr. H. F. Blanford becoming meteorological reporter for the government of Bengal in June, 1867. A system of provincial meteorological departments, independent of each other, therefore came into existence, and, as was to be expected, it proved to be very unsatisfactory.

Period 3, from 1875 to date.—In 1874 Mr. H. F. Blanford was appointed imperial reporter to superintend the work of meteorological observatories over the whole of India, with power to initiate and control the work and expand the department. He took up the work the following year.

After unifying the meteorological work of India, the next step was to coordinate this system with that of other countries adjacent to the Indian Ocean, and with that of Europe. An effort was also made to extend the field of observation so as to cover the neighboring portions of the Indian Ocean, with a view to a systematic study of the dynamics of the monsoon winds of India.

In 1878 Mr. Eliot, as meteorological reporter for Bengal, made his first forecast of the probable character of the monsoon winds for the coming season,[1] and on June 15, 1878, he inaugurated a system of daily telegraphic weather observations from all parts of India. The code used was based on the system adopted by the American Weather Signal Service.

In 1881 a commission that had been appointed to inquire into the Madras famine of 1876–77 pointed out a probable relation between the seasonal distribution of rainfall in India and the sun-spot periodicity, and recommended an investigation of the subject. The work of the famine commission was amplified by Blanford, and among other things actinometric observations were undertaken at Leah, in 1883, and were successfully conducted at Simla from 1889 to 1895.

Also in 1881, Mr. Eliot, as meteorological reporter to the government of Bengal, inaugurated an extension to the system of storm warnings that had been in existence at the port of Calcutta since 1865, and commenced the collection of meteorological reports from the log books of ships entering the port of Calcutta.

Mr. W. L. Dallas, who was appointed scientific assistant in 1882, undertook the work of reducing and discussing for publication the observations taken on the Indian seas and collected by the London Meteorological Office.

In 1883 the publication of a daily weather report and chart for the Province of Bengal was authorized by the government of India.

In 1885 a system of flood warnings was inaugurated for the Nerbudda and Tapti rivers and a forecast for the southwest monsoon rains was issued. This was the first of a series of diurnal forecasts which has been issued and published in the Gazette of India during the past sixteen years.

Mr. Blanford went on furlough in 1886 and Mr. Eliot was appointed to act for him. Mr. Blanford deciding not to return, he was retired, and Mr. Eliot succeeded him as imperial reporter in May, 1889. The work for the next few years consisted mainly in perfecting and extending the system that had been outlined by Mr. Blanford. The following summary by Mr. Eliot will indicate the scope of this work:

(1) The number of observatories working under or in connection with the department furnishing information for inclusion in the daily weather reports and monthly reviews has been increased from 135 on April 1, 1887, to 230 on March 31, 1901. The increase is hence 95 in number, or 70 per cent of the number in 1886–87.

(2) The number of ports warned on the Indian coast has been increased from 15 in 1886–87 to 45 in 1900–1901, an increase of 200 per cent. The system of storm signals has been improved and additional signals introduced to meet defects shown by actual working and experience.

(3) Current weather information is now placed as rapidly before the more important governments and public as is possible under the conditions of Indian telegraphic and postal facilities.

(4) In 1886–87 there were only three daily weather reports issued for the information of government and the public, viz, the Simla and the Bay of Bengal reports of which only the latter was illustrated by a chart. There are now issued five daily weather reports and charts, of which the following give data:

	No. of stations, 1886–87.	No. of stations, 1900–1901.
India daily weather report.....	97	158
Bay of Bengal daily weather report .	20	28
Bengal daily weather report.....	41	66
Bombay daily weather report.....	0	54
Madras daily weather report	0	39

(5) The introduction of a uniform system for the registration of rainfall throughout India (more especially the adoption of a common type of rain gage, common hour of registration, and methods of inspection) and for the publication of the data of observation. The number of rain-gage stations has been increased to some extent, chiefly by increase in Rajputana, central India, Baluchistan, Kashmir, and other districts in which the work was previously very imperfectly performed. An important improvement in connection with this was the introduction of weekly rainfall reports and of charts showing the distribution of the rainfall of each season to date, for the information of the government of India.

(6) A large extension of the work of collecting meteorological information relating to the Indian seas. The data now systematically collected are sufficient to enable daily weather charts (daily weather charts of the monsoon area) to be prepared which show the character of the weather changes in the sea area almost as fully as is done for the land area by the charts in the daily weather reports. Pilot charts for the Indian seas are, as a result of this, now prepared and issued by the office.

[1] In July, 1874, Mr. W. G. Wilton had made similar forecasts for the Indian government.

(7) The establishment of a solar physics observatory for the systematic examination and study of the changes in progress in the sun and their correlation with the larger features of Indian meteorology and the transfer of the Magnetic Observatory at Colaba and the Astronomical Observatory at Madras from provincial to imperial control.

The present work of the department and the chief directions in which extension is desirable may be classified under the following heads:

(1) The collection of accurate meteorological data from a sufficient number of representative stations to give the chief facts of the climatology of India and to furnish data for the issue of the various reports and warnings of the department.

(2) Special meteorological investigations.

(3) Seasonal forecasts.

(4) Marine meteorology.

(5) Daily weather reports.

(6) Issue of flood and storm warnings.

The work under the second head admits of very large and special development. Little or nothing is known of the depth of the seasonal atmospheric currents in India. Kite or balloon investigations are hence greatly to be desired. Similarly the relations of sun spots and terrestrial magnetism to Indian meteorology are deserving of a full and careful investigation, for which there is probably sufficient accurate material to enable these questions to be usefully discussed.

A reference to my opinion given in 1878 expresses fully the directions in which I believe now, as then, extension of observation and comparison is necessary in order to increase the value of the seasonal forecasts. Slight extensions have been slowly and tentatively made during recent years, but if further improvement be desired it will be necessary to collect and compare data from a much wider area than has hitherto been possible with the limited available means.

The opinion given in 1878 by Mr. Eliot had reference to "the coordination of the meteorology of India with that of the various countries adjoining the Indian Ocean, and also with that of Europe," for the purpose of studying the two great monsoon currents of India and their possible relation to the variations in the annual rainfall in India, as well as the relation between these variations and the solar radiation and the evaporation over the area which forms the source of the rains of south Asia.

This illustrates the broad policy upon which the Indian Meteorological Office has been conducted during the administration of Mr. Eliot. It is the same as the policy that has led to the expansion of our own Weather Bureau to include reports from the Atlantic and Pacific oceans, Canada, Mexico, Central America, and the West Indies, and from such expansions meteorology is deriving decided benefit.—*H. H. K.*

PAMPHLETS RELATIVE TO WETTERSCHIESSEN.

No. 1. G. Suschnig. Bericht über den Verlauf des dritten internat. Wetterschiess Congresses zu Lyon am 15, 16 und 17 November, 1901.

No. 2. G. Suschnig. Referat über die Erfolge und Beobachtungen beim Wetterschiessen in Oesterreich erstattet dem III. internationalen Wetterschiess Congresse in Lyon am 15 November, 1901.

No. 3. Rudolf Szutsek. Bericht über das Wetterschiessen im Landes-Schiess-Rayon zu Windisch-Feistritz, in den Jahren 1900, 1901. Bearbeitet von Rudolf Szutsek, k. u. k. Oberstlieutenant I. R. Leiter des obigen Landes-Schiess-Rayons. Graz, 1901.

This pamphlet of 16 pages and 2 charts contains a most satisfactory detailed account of the methods and operations at the headquarters of the hail shooting system. It contains the results of careful observations of the hailstorms and of the effect of the shooting. The charts show the irregularity in the distribution of hail from the ordinary storms as well as the irregularities in the movements of these storms, of which there were 8 in 1900, and 7 in 1901. We should say that just as Dyrenforth's explosions of dynamite were observed to be followed by rain, or accompanied by rain, or preceded by rain, according as the observers happened to be in front of, or under, or in the rear of a passing shower, thereby demonstrating its utter inefficiency, so with the cannonading and the hail at Windisch-Feistritz. However, on this latter point Lieutenant Szutsek, on page 14, says:

> Although no certain conclusions can be drawn from the previous observations because we have too little material on hand, still the results give some ground for the hope that the question whether hail shooting is efficacious, whose solution the whole world awaits with anxiety, can be answered in the near future.

No. 4. G. Suschnig. Das Wetterschiessen. Graz. 1901. This is a very interesting general history of the subject from 1750 to May, 1901. It gives an excellent bibliography of the subject and is apparently prepared for distribution at the Congress at Lyons.—*C. A.*

THE THIRD INTERNATIONAL CONGRESS ON HAIL SHOOTING.

On a following page we publish a translation of the whole of the report offered to the Third International Congress at Lyons in November last, by Prof. J. R. Plumandon, Director of the Meteorological Observatory on the Puy-de-Dôme in southern France. The extent to which cannonading against hail has spread through Italy, Austria, and France is well shown by the reports presented at the Congress at Lyons. The general report of the proceedings of the congress has been prepared by G. Suschnig, the indefatigable agent of the iron manufacturing firm of Carl Greinitz and Nephews at Gratz, Austria. According to this publication reports were received at the congress from the following persons:

1. Professor Battanchon on the general history of the subject of weather shooting.

2. Guinand, on the results in France, during 1901, where 39 operators with 834 cannon protected 22,900 hectares. He reported perfect success in every case; on this Suschnig remarks that he is altogether too optimistic, and that his enthusiasm needs to be modified by a careful discussion of the French data such as has already been done for Austria.

3. Suschnig, a general report for Austria. After a short sketch of the literature of the subject since 1750, in Austria, he gives a special description of the present state of affairs in the various provinces of Styria, lower Austria, Krain (Carniola), the Adriatic coast, Dalmatia, upper Austria, the Tyrol, and the Kaernten (Carinthia). In summarizing the results, he states that they have investigated thoroughly the efficiency of the cannon, and the altitude to which the vortex rings ascend, viz., three or four hundred meters. They have also begun a laborious investigation, as yet unfinished, into the laws of the movements of the vortex rings. He is endeavoring to respond to the general demand for accurate data as to the operations themselves. In general, every one is thoroughly satisfied with the results and no one doubts but that systematic shooting has accomplished good results.

4. Konkoly, for Hungary. The experience of the year has shown that the practical service leaves much to be desired, and the reporter, therefore, expresses the greatest reserve in judging of the value of the shooting.

5. Ottavi, for Piedmont, Italy. Although there were many hailstorms yet the stations were generally well protected, but there were three cases of severe extensive damage to the protected as well as the unprotected, namely, on May 17, June 12, and July 22. In many cases the shooting seems to be effective against hail, but in many others not so.

6. Alpe, for Lombardy. The shooting stations generally report good results, but cases of failure are believed to be the consequence of poor organization, feeble cannon or delay in shooting; nevertheless the severe misfortune at Mantua occurred in spite of perfect shooting and can not be excused.

7. Marescalchi, for Emilia.

8. Marconi, for Venice.